NON-PUBLIC?: N
ACCESSION #: 9111180339
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Kewaunee Nuclear Power Plant PAGE: 1 OF 14

DOCKET NUMBER: 05000305

TITLE: Unit Trip Due To Inadequate Non-Safeguard Breaker Coordination
EVENT DATE: 10/12/91 LER #: 91-010-00 REPORT D
TE: 11/11/91

OTHER FACILITIES INVOLVED: NA DOCKET NO: 05000

OPERATING MODE: N POWER LEVEL: 099

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(i) and 50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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COMPONENT FAILURE DESCRIPTION:
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE NPRDS:

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT:

At 1400 CDT on October 12, 1991, with the plant at full power, a reactor/ turbine trip occurred returning equipment to service during the implementation of Preventive Maintenance Procedure (PMP) 38-10, "DC Supply and Distribution (EDC) 20 KVA Inverter Maintenance." During this process 125 VDC Distribution Cabinet BRD-103 was de-energized as a result of inadequate non-safeguard breaker coordination. This de-energization caused the feedwater regulating valves (FW-7A and B) to close, resulting in a trip signal from the subsequent steam flow-feedwater flow mismatch coincident with low water level in steam generator A. As expected, the auxiliary feedwater pumps started, which was an ESF actuation, in response to plant conditions.

A main contributor to this event was inadequate coordination between the 300 amp breaker which supplies 125 VDC Distribution Cabinet BRD-103 and

the 200 amp breaker from BRD-103 to a non-safeguard inverter. To prevent recurrence the magnetic trip settings of the respective breakers were adjusted accordingly. In addition, any modifications necessary to further ensure proper coordination of non-safeguard DC breakers will be scheduled for the 1992 refueling outage.

The plant safety systems responded as designed and the operators followed appropriate recovery procedures for plant stabilization. In addition to the plant trip and corresponding ESF actuation, a Technical Specification required instrument channel check was not performed during recovery activities on the shift immediately following the plant trip.

This event is being reported as required by 10 CFR 50.73(a)(2)(iv) and 10 CFR 50.73(a)(2)(i).

END OF ABSTRACT

Description of Event

At 1400 CDT on October 12, 1991, with the plant at full power, a reactor/turbine RCT/TRB! trip occurred while returning equipment to service during the implementation of Preventive Maintenance Procedure (PMP) 38-10, "DC Supply and Distribution (EDC) 20 KVA Inverter INVT! Maintenance." During this procedure the supply breaker 72! to BRD-103, a non-safeguard 125 VDC Distribution Cabinet CAB!, opened on overcurrent de-energizing the cabinet. This de-energization caused the feedwater regulating valves (FW-7A and B) FCV! to close, resulting in a trip signal from the subsequent steam flow-feedwater flow mismatch coincident with low water level in steam generator SG! A. The auxiliary feedwater BA! pumps P! started, which is an expected ESF actuation in response to a plant trip.

At 0625 CDT on October 12, 1991, Preventive Maintenance Procedure 38-10 was initiated to facilitate the replacement of circuit breakers and lamps IL! in a non-safeguard power panel PL! and inverter. Per this procedure, the inverter was de-energized by opening the 200 amp feeder breaker (CKT BKR #1) from the 125 VDC distribution panel (BRD-103) (reference Figure 1). Subsequently, all planned maintenance was completed.

Upon completion of the maintenance activities, the electrician began the "relineup" portion of the procedure. The "relineup" included returning isolation breakers to their specified positions. The electrician closed CKT BKR #1 in BRD-103 to restore DC power to the inverter, Within

seconds after the closure of this breaker the status lamps on BRD-103 went out, indicating that power to BRD-103 had been lost. In addition, some non-safeguard control and protection features were lost and the associated control room annunciators ANN! were alarmed.

Immediate investigation revealed that the 300 amp feeder breaker (CKT BKR #4), which supplies power from BRD-102 to BRD-103, had tripped open. In addition to the non-safeguard inverter, other significant loads powered from BRD-103 that were de-energized included:

o the pilot solenoid SOL! valves V! for the feedwater regulating valves (FW 7A and B)

o Bus BU! 1-46 control and protection relaying RLY!

o the Technical Support Center Diesel Generator DG! control and protection relaying

o the Main Generator GEN! lockout protection 86!

o Bus 1-2 and Bus 1-4 control and protection relaying.

When power was lost to BRD-103, the feedwater regulating valves (FW 7A & B) failed in the closed position resulting in a steam flow-feedwater flow mismatch. This, coincident with the subsequent low level in "A" steam generator, resulted in a reactor trip at 1400 CDT. Recognizing what had occurred, the electrician immediately contacted the control room. With Operations concurrence, the electrician opened CKT BKR #1 on BRD-103 and closed CKT BKR #4 on BRD-102, restoring power to BRD-103. BRD-103 was de-energized for approximately 12 minutes.

Loss of the main generator lockout protection resulted in motoring the main generator for approximately 2 minutes. The operators then took manual action to trip the main output breaker. Loss of the lockout protection also disabled the auto-transfer feature for the electrical distribution buses normally powered from the Main Auxiliary Transformer (MAT) XFMR!. As a result "A" reactor coolant AB! pump, which is powered from a MAT distribution bus, stopped after the operators manually opened the main generator isolation breaker. Also, the loss of control and protection relaying previously described resulted in several erratic instrument indications in the control room. However, this instrument

indication involved only non-safeguard equipment and was immediately restored upon the re-energization of BRD-103.

Plant safety systems responded as designed and the operators followed appropriate recovery procedures for plant stabilization. The NRC was notified of this plant evolution in accordance with the requirements of 10 CFR 50.72(b)(2)(ii) at 1703 CDT.

The plant was maintained at hot shutdown while a post-trip review was performed. Investigation by the Plant Electrical Maintenance group determined that there was a high probability of a breaker coordination problem between the 300 amp supply breaker (CKT BKR #4 on BRD-102) to BRD-103 and the 200 amp breaker (CKT BKR #1 on BRD-103) which feeds the non-safeguard inverter from BRD-103. This was based on the "out of sequence" tripping of the 300 amp breaker and the as-found magnetic trip settings of the respective breakers. The 300

breaker (CKT BKR #4) was set at the minimum magnetic trip setting and the 200 amp breaker (CKT BKR #1) was set at the maximum magnetic trip setting.

The Plant Electrical Maintenance group then investigated the cause of the apparent in-rush current which resulted in the tripping of CKT BKR #4. The electrical lineup at the time CKT BKR #4 tripped was verified. From that verification it was determined that when CKT BKR #1 was closed only the DC filter FLT! capacitor CAP! bank for the non-safeguard inverter was energized. The filter capacitor bank was examined and there were no apparent short circuits across capacitors, no ruptures, and no signs of arcing or burns.

CKT BKR #1 was then removed from BRD-103 and tested. The CKT BKR #1 insulation ISL!, associated cable CBL!, and capacitor bank were meggered. All test and megger results were acceptable. CKT BKR #1 was re-installed in BRD-103.

After qualitatively evaluating the potential consequences of altering breaker settings on this portion of the non-safeguard distribution system, Operations and the Electrical Maintenance group jointly decided to lower the magnetic trip setting on CKT BKR #1 (200 amp) to minimum and raise the setting on CKT BKR #4 (300 amp) to maximum, improving coordination between these breakers. The capacitor bank was then pre-charged to 132 VDC. The system "relineup" was resumed, again using PMP 38-10. Upon closure of CKT BKR #1 the non-safeguard inverter picked up load with no additional problems.

In addition to and as a result of' the plant trip, Surveillance Procedure (SP) 87-125, "Shift Instrument Channel Checks-Operating," was not performed during the 1500-2300 shift on October 12, 1991. This SP is required to be performed once per shift when above cold shutdown. It was missed due to Operations personnel involvement in plant recovery activities and startup preparation following the plant trip which occurred at 1400 CDT on October 12, 1991.

It should be noted that during plant recovery and plant startup preparation activities Operations personnel routinely monitored instrument channels included in SP 87-125. Also, plant conditions were verified during the periodic reviews of computer logs for unusual trends. As would be expected, there was a heightened awareness of key plant parameters during this plant evolution. Therefore, although not formally performed and documented, the intent of SP 87-125 was met and there were no adverse consequences. SP 87-125 had been performed on the prior shift and was performed on the subsequent shift. No anomalies were identified in either instance.

The reactor was returned to criticality at 0137 on October 13, 1991. The turbine/generator TG! was then reconnected to the grid at 1622 on the same day.

Subsequent to plant startup the time response curves for these respective breakers were compared and it was determined that sufficient overlap did exist, at their respective as-found magnetic trip settings, for the 300 amp breaker to trip before the 200 amp breaker under certain current

conditions. The manufacturer of the filter capacitor bank was then contacted to determine in-rush charging current under the conditions described herein. This current demand was then compared with the overlap in the time response curves of the respective breakers. This comparison conclusively demonstrated that the in-rush charging current to the filter capacitor bank, in conjunction with the inadequate breaker coordination, resulted in the 300 amp breaker (CKT BKR #4) tripping before the 200 amp breaker (CKT BKR #1).

Cause of Event

Inadequate coordination between the 300 amp breaker (CKT BKR #4) which feeds 125 VDC Distribution Cabinet BRD-103, and the 200 amp breaker (CKT

BKR #1) from BRD-103 to a non-safeguard inverter was a main contributor to this event. This coordination concern was identified after the implementation of Design Change Request (DCR) 2393, which installed CKT BKR #4 and modified the plant DC distribution system during the 1990 refueling outage.

Although general breaker coordination concerns were identified, individual deficiencies were not characterized and engineering resources were directed at issues of higher priority.

Prior to the implementation of DCR 2393, BRD-103 had been designated as BRB-103 and was a safeguard 125 VDC Distribution Panel. Under DCR 2393, BRB-103 was stripped of its safeguard loads (but retained the non-safeguard inverter described in this event), renamed BRD-103, reconfigured to supply power to the additional non-safeguard loads previously described, and was repowered from BRD-102. The existing 200 amp breaker (CKT BKR #1) on BRD-103

(previously BRB-103) remained unchanged and prior to DCR 2393 the same non-safeguard inverter involved had been de-energized and successfully re-energized several times during the performance of maintenance activities similar to those which preceded this event. However, the 300 amp breaker (CKT BKR #4) currently on BRD-102 was installed under DCR 2393, and is a different model breaker with different time-response characteristics than the breaker which fed BRB-103 prior to the modification. When BRD-103 was connected to BRD-102, it was done in an energized condition, and therefore CKT BKR #4 on BRD-102 had not been previously exposed to the in-rush current involved in charging the capacitor bank.

The scope of DCR 2393 also included the installation of new non-safeguard batteries. These modifications were prompted by the results of an internal Safety System Functional Inspection of the DC Supply and Distribution System. They were intended to redistribute some of the safeguard and non-safeguard loads so as to enhance plant operation and the reliability of PC power sources for safeguard equipment.

Breaker coordination studies were performed for the safeguard portions of the DC system modifications at the time of the 1990 refueling outage. The results of this study indicated that the safeguard DC breaker coordination was adequate. Based on these favorable results, and time constraints imposed by other engineering activities, breaker coordination studies for the nonsafeguard DC system modifications were deferred.

In an unrelated failure-effects analysis, the Safety System Engineering group (which is responsible for the performance of Safety System Functional Inspections) reviewed the modified DC distribution configuration and identified some concerns pertaining to the loads on BRD-103. This review accurately predicted the events that occurred upon loss of power to BRD-103, including motoring of the main generator. Additionally, it pointed out that the loss of the main generator lockout protection would prevent the automatic transfer of the four non-safeguard 4160V buses to an alternate transformer.

This review was completed in April of 1990 and management was made aware of the vulnerabilities associated with an event involving de-energization of BRD-103. Recognizing the potential impact of the loss of BRD-103 on plant operation, measures were immediately taken to minimize the equipment affected under that scenario. These measures included the re-alignment of two of the four non-safeguard 4160V buses to an alternate transformer, thus ensuring the availability of non-safeguard equipment upon loss of BRD-103. Also, a summary of the Safety System Engineering review, including the events anticipated to occur upon loss of power to BRD-103, was included in a Night Order dated April 9, 1990 which was required reading for all shift supervisors and control room supervisors. All of these measures aided the operators in coping with this event.

The non-safeguard breaker coordination studies were completed in July of 1990. Although these studies did not address the specific relationship between the 300 amp breaker (CKT BKR #4)

and the 200 amp breaker (CKT BKR #1) involved in this event, concerns were raised regarding the trip point of CKT BKR #4. An Engineering Support Request (ESR) was initiated to evaluate this situation and develop appropriate recommendations. This ESR determined that additional modifications would be necessary to ensure proper breaker coordination and DCR 2566 was written to accomplish that task. Implementation of DCR 2566 would have resolved the breaker coordination concerns, precluding this event.

Although these non-safeguard breaker coordination concerns had been identified, DCR 2566 was not implemented due to its priority relative to other DCRs. The risk of adverse impact on plant operation with the existing configuration was considered to be low. As a result, a deliberate decision was made to defer DCR 2566. It will now be re-prioritized such that implementation will be scheduled for the 1992

refueling outage.

As stated previously, SP 87-125 was not performed during the shift immediately following the plant trip. This violated plant Technical Specification requirements. The performance of this instrument surveillance was missed due to Operations involvement with plant recovery activities and preparation for plant startup.

Analysis of Event

This report is being submitted per 10 CFR 50.73(a)(2)(iv) as an automatic actuation of the Reactor Protection System and Engineered Safety Features and per 10 CFR 50.73(a)(2)(i) as an operation prohibited by the plant's Technical Specifications.

Plant operators followed appropriate plant procedures for recovery and stabilized the plant. All plant safety systems responded as designed. All three auxiliary feedwater pumps started, both reactor trip breakers opened, and the reactor was shut down. Both steam generators were available for decay heat removal and off-site power was available throughout the event. There was no impact on public health and safety.

Although a Technical Specification surveillance requirement was not met during one shift, plant parameters were monitored. Therefore, although not formally performed and documented, the intent of SP 87-125 was met and there were no adverse consequences. Also, SP 87-125 had been performed on the prior shift and was performed on the subsequent shift. No anomalies were identified in either instance.

Corrective Actions

Corrective actions initiated in response to this event have included the following:

o The magnetic trip setting on the 200 amp breaker (CKT BKR #1) has been set at the minimum setting and the magnetic trip setting on the 300 amp breaker (CKT BKR #4) has been set at the maximum setting, thus improving coordination between these two breakers.

o A Night Order has been issued requiring Operations Management approval prior to performing any corrective or preventive

maintenance on non-safeguards DC equipment until the breaker coordination problems have been corrected.

o A danger card has been placed on the affected inverter stating that if the inverter becomes de-energized the maintenance group should be contacted so that the filter capacitor bank can be precharged prior to reclosing CKT BKR #1 on BRD-103. This will remain in place until the breaker coordination issue is resolved.

o The priority of DCR 2566 will be raised such that the identified non-safeguard DC breaker coordination concerns will be resolved and any associated modifications will be scheduled for implementation during the 1992 refueling outage.

o Operations personnel have been reminded of the importance of performing surveillance requirements within the specified intervals.

o This event will be included in Technical Staff and Management training for engineering personnel.

Similar Events

None.

Equipment Failures

No equipment failures were involved.

Figure 1 "Schematic Of BRD-103 and Its Primary Loads" omitted.

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November 11, 1991 10 CFR 50.73

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Reportable Occurrence 91-010-00

The attached Licensee Event Report for reportable occurrence 91-010-00 is being submitted in accordance with the requirements of 10 CFR 50.73, "Licensee Event Report System."

Sincerely,

C. A. Schrock
Manager-Nuclear Engineering

PEM/jms

Attach.

cc - INPO Records Center
Mr. Patrick Castleman, US NRC
US NRC, Region III

*** END OF DOCUMENT ***